



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

BULLETIN
OF THE
TORREY BOTANICAL CLUB.

Vol. XVIII.]

New York, July 1, 1891.

[No. 7.

A Comparative Study of the Styles of Compositæ.

By J. S. CHAMBERLAIN.

Plates CXIX-CXX.

(Continued from page 186).

HELIANTHOIDEÆ (Plate CXIX, Fig. 1-36).

Gray³⁷ says: "Style branches of hermaphrodite or sterile flowers (or the undivided style in some of the latter) truncate or continued in a hairy appendage."

Bentham³⁸ says: "Style branches vary in different genera from the truncate tips of the *Senecio* to the appendiculate branches of *Asteroideæ*, or the subulate hispid branches of *Vernoniaceæ*."

In this tribe, as stated by Gray and Bentham, there is considerable variation. Yet this variation, as far as my observations go, would enable us to make a division of the tribe, as in *Asteroideæ*, though not so marked. The styles of the sterile hermaphrodite disk flowers are undivided, except in *Polymnia*, with a truncate bunch of brush hairs, or the brush hairs covering the entire surface. These characters are constant in all genera I have studied. The style of the pistillate flowers is also uniform, being either two-branched with the branches linear, acute with stigmatic papillæ in two rather wide lines along the edges, or they occupy the entire inner surface. In all cases the style of the fertile hermaphrodite flowers is two-branched. The stigmatic papillæ occurring on the inner surface and the brush hairs form a triangular appendage at the tip.

³⁷ L. c., p. 59.

³⁸ L. c., p. 379.

On these characters the following division of the tribe could be made :

DIVISION I.

Hermaphrodite florets sterile, style entire, except in *Polymnia*, with a truncate appendage of brush hairs, or linear obtuse with brush hairs covering the whole surface. This division includes the genera : *Silphium*, *Polymnia*, *Berlandiera*, *Iva* and *Xanthium*.

DIVISION II.

Hermaphrodite flowers fertile, with a two-branched style. The branches have a triangular tip, the brush hairs cover the outer surface of the branch, and extend down a part or the entire distance to the base, occurring also on the inner surface at the very tip. The papillæ cover the entire inner face or occur in two very wide lines. This division includes the genera : *Helianthus*, *Tetragonotheca*, *Eclipta*, *Echinacea*, *Rudbeckia*, *Lepachys*, *Borrchia*, *Actinomeris*, *Coreopsis*, *Bidens*, *Baldwinia* and *Galinsoga*.

DIVISION I.

*Silphium*³⁹ (Plate CXIX, Fig. 1-5).

S. perfoliatum, L. Style of the hermaphrodite sterile flowers entire, cylindrical, obtuse. Brush hairs cover the entire surface for about three-fourths of its length (Fig. 4). They are large, broad at the base, and with an acute point (Fig. 5). Style branches of the pistillate flowers long and acute. Stigmatic papillæ cover the entire inner surface (Figs. 1, 2). The papillæ (Fig. 3) are short and obtuse.

*Polymnia*⁴⁰ (Fig. 6).

P. Canadensis, L. Sterile style is two cleft. The branches are entirely covered with brush hairs, which are very short and broad (Fig. 6).

Berlandiera (Fig. 7).

B. subcaulis, Nutt. The branches of the pistillate flowers are smaller than in *Silphium*, and the papillæ are in two wide

³⁹ Gray, l. c., p. 61. Hildebrand, l. c., p. 29.

⁴⁰ Gray, l. c., p. 60.

lines along the edges of the branch. Papillæ are shaped similar to those of *Silphium* (Fig. 7).

Iva (Fig. 8-10).

I. xanthiifolia, Nutt. The style of sterile hermaphrodite flowers is undivided, narrow at the base, and gradually enlarging to the tip. The brush hairs are in a truncate tuft at the tip of the style (Fig. 9). Brush hairs obtuse and not as long as in *Silphium* (Fig. 10). The branches of the pistillate style are short, acute, with the stigmatic papillæ in two lines along the edges. The papillæ (Fig. 8) are more acuminate than in *Silphium*.

Xanthium (Fig. 11-13).

X. echinatum, L. The style of the sterile hermaphrodite flower is nearly cylindrical, undivided, with brush hairs covering the entire surface for about one-fifth of the length of the style (Fig. 12). Brush hairs broadly obtuse (Fig. 13). Stigmatic papillæ are rather large and somewhat acute (Fig. 11).

DIVISION II.

Helianthus, (Plate CXIX, Fig. 27, 28).

H. rigidus, Desf. The branches have a triangular shaped tip with the brush hairs covering the entire outer face and the tip of the inner face. The stigmatic papillæ cover the entire inner face except the tip (Figs. 27, 28). The brush hairs are large and acuminate. In *H. tuberosus* the three cleft style was also found. In some of these three cleft styles it seemed as though the third branch was formed by the division of one of two original branches, but in most cases all three of the branches were of equal length and seemed to be wholly separate.

Heliopsis (Fig. 14, 15).

H. helianthoides (L.), B. S. P. The style is the same as in *Helianthus*. The brush hairs do not cover the entire outer surface, but only the outer tip. The papillæ cover the entire inner face, or are in two very wide lines, appearing as one wide line occupying the whole inner surface.

The stigmatic papillæ (Fig. 15) are larger than those of *Silphium*, while the brush hairs (Fig. 14) are smaller.

Tetragonotheca (Fig. 16, 17).

T. Ludoviciana (T. & G.), Gray. The branches of the style have a very slender tip. The brush hairs cover the outer face along the upper two-thirds of the branch. The longest hairs occur where the branches begin to taper. The papillæ are in two lines along the edges of the inner face and are of about average size (Fig. 17). The brush hairs (Fig. 16) are larger than those of any other genus studied.

Eclipta (Fig. 18).

E. alba (L.), Hassk. The style has the same general structure as in *Helianthus*, but it was so small that the exact form was hard to determine. The papillæ (fig. 18) are short and obtuse.

Echinacea (Fig. 19-20).

E. angustifolia, DC. Branches of the style long and tapering. The brush hairs occupy a little more than one-half of the branch, covering the outer face and the tip of the inner. The longest hairs occur just below the tip, (fig. 19). The papillæ cover the entire inner surface and are of average size, (fig. 20).

Rudbeckia (Fig. 21-22).

R. subtomentosa, Pursh. The branches are like those of *Helianthus* except they do not taper so much. The long and slender brush hairs cover the outer face of the branches for their whole length, (fig. 21). The papillæ, (fig. 22) cover the entire inner face.

Lepachys (Fig. 23-24).

L. pinnata (Vent.), Torr. & Gray. Style branches a little shorter than in *Helianthus*, very slender, tapering above the end of the stigmatic lines. Brush hairs cover not only the outer face for nearly its entire length, but also the inner face above the end of the stigmatic lines. As compared with *Rudbeckia* the hairs are short and broad, (fig. 23). The papillæ are in two lines on the inner face for about one-half the length of the branch. They are very short and obtuse, (fig. 24).

Borrchia (Fig. 25-26).

B. arborescens (L.), DC. The branches are slender and about one and a half times as long as in *Helianthus*. The brush

hairs cover the tip of the inner face and the entire outer for about half of its length, (fig. 25). The large stigmatic papillæ cover the entire inner face, (fig. 26).

Actinomeris (Fig. 29-30).

A. alternifolia (L.), DC. Branches much the same as in *Helianthus*. The brush hairs, which are most abundant at the tip, cover the entire outer face nearly the entire length of the branch. They are broader and shorter than in most of the other genera, (fig. 29). The papillæ are in two very wide lines on the inner face and are quite small and narrow, (fig. 30).

Coreopsis (Fig. 31-35).

C. palmata, Nutt. The entire style is in general like *Helianthus* (fig. 31-35).

Galinsoga (Fig. 36).

G. parviflora, Cav. Branches of the style about one-fourth as long as *Helianthus*. Brush hairs cover the outer face for about two-thirds of its length, (fig. 36). Papillæ are in two broad lines on the inner face.

HELENOIDEÆ^{4†} (Plate CXIX. Fig. 37-42). ANTHEMIDEÆ^{4†} (Plate CXX. Fig. 1-8). SENECTIONIDEÆ^{4†} (Plate CXX. Fig. 8-14).

These tribes will be considered together since the styles are much alike. In all three tribes the hermaphrodite perfect flowers have a two branched style with the brush hairs either (1) in a truncate bunch at the tip of the branch, or (2) covering the entire or part of the outer face of the branches and forming a slightly triangular tip.

In the three genera of Anthemideæ which I have examined, the truncate bunch of brush hairs is present, and the stigmatic papillæ are arranged in two lines along the edges of the inner face. In Helenioideæ two of the three genera examined had the truncate bunch of brush hairs as in Anthemideæ, the other genus having long and somewhat triangular tipped branches, with the brush hairs covering a part of the outer surface. In Senecionideæ one of the three genera examined has the truncate bunch of brush hairs, the two others have a triangular or an obtuse tipped

^{4†} Gray, l. c. pp. 70, 77, 79. Benthams, l. c. pp. 381, 382, 384.

branch with the brush hairs on the outer face? In these tribes, therefore, the style characters are not uniform. They are of two divisions, one of which might be mistaken for *Helianthoideæ*.

HELENIOIDEÆ, (Plate CXIX. Fig. 37-42).

DIVISION I.

The style branches of the hermaphrodite perfect flowers are short, with a distinct bunch of brush hairs at the tip. Papillæ arranged in two comparatively wide lines along the edges of the flattened branches. This division includes the genera *Helenium* and *Actinella*.

DIVISION II.

Branches of the style in the hermaphrodite perfect flowers are considerably longer than in division I, brush hairs distinctly not truncate forming only a slight enlargement. Brush hairs occupy the outer face for about one-third of its length. The papillæ are in two lines on the inner face. This division includes the genus *Dysodia*.

Helenium (Fig. 37-40).

H. autumnale, L. Style branches are essentially as described in division I. The brush hairs (fig. 39) are cylindrical, obtuse. The papillæ, (fig. 40) are short and obtuse.

Actinella (Fig. 41-42).

A. linearifolia (Hook.), Torr. & Gray. Style branches as in *Helenium*, only somewhat broader and shorter. Brush hairs as in Fig. 41, and stigmatic papillæ as in Fig. 42.

Dysodia (Fig. 43).

D. chrysanthemoides, Lag. Branches of the style as described for division II. Brush hairs shorter and broader than in *Helenium*.

ANTHEMIDEÆ (Plate CXX. Fig. 1-10).

In the *Anthemideæ* the three genera examined have a truncate bunch of brush hairs, as division I of *Helenioideæ*. The style branches are somewhat broader and shorter than in that tribe.

Achillea (Fig. 1-4).

A. Millefolium, L. The style branches the same as in the tribe (fig. 1-3). The brush hairs (fig. 4) are broad and short.

Matricaria (Fig. 5).

M. inodora, L. Branches of the style in the perfect hermaphrodite flowers are like those of *Achillea* but not so long, which applies also to the brush hairs and papillæ.

Artemisia (Fig. 6-10).

A. Ludoviciana, Nutt. Style branches of perfect hermaphrodite flowers same as in *Achillea* but shorter. Brush hairs (fig. 8) are longer and narrower. Papillæ (fig. 9-10) are a little larger. The style branches of the pistillate flower, acute with the papillæ in two lines along the edges, (fig. 6-7).

SENECIONIDEÆ (Plate CXX. Fig. 11-16).

Two kinds of styles occur in *Senecionideæ* corresponding to those of *Helenioideæ*. The first division with a truncate bunch of brush hairs as in *Senecio*. The second division with triangular or obtuse tips is represented by *Petasites* and *Arnica*.

Senecio (Fig. 11-12).

S. aureus, L. The style branches are as in division I of *Helenioideæ*. Brush hairs (fig. 11) are almost like those of *Artemisia*, but more acute. Papillæ shown at Fig. 12.

Petasites (Fig. 13-14).

P. palmata (Ait.), Gray. Branches of the style are very short compared with its length. The tips of the branches are somewhat triangular. Brush hairs cover the outer faces entirely, the longest ones being at the tip. Papillæ cover the entire inner surface except a small part at the tip (fig. 13). Brush hairs from the tip and base of branch (fig. 14).

Arnica (Fig. 15-16).

A. Chamissonis, Less. Branches of the style terete or nearly so, and obtusely tipped. Brush hairs (fig. 16) cover the outer face for about two-thirds of its length. They are longer and more numerous at the tip. The stigmatic papillæ (fig. 15) in two wide lines on the inner face with only a very narrow zone between them.

CYNAROIDEÆ (Plate CXX, fig. 17-21).

Branches of the style in the perfect hermaphrodite flowers are obtusely or slightly acutely pointed. The brush hairs cover the

entire outer face as far down as the base of the branches and sometimes farther. The papillæ are in two lines or cover the entire inner face.

Cnicus (Fig. 17-18).

C. altissimus, var. *discolor* (Muhl.), Gray. The style branches are very long cylindrical with a slight acute tip. The brush hairs cover the entire outer face as far down as the base of the branches, ending just below the base of the branches in a tuft of somewhat longer hairs (Fig. 17). The papillæ are in two moderately wide lines on the inner face, and extend the whole length of the branch. The brush hairs (fig. 18) are rather short and acute.

Centaurea (Fig. 19-21).

C. Americana, Nutt. Branches of the style are very short and obtuse. Brush hairs cover the entire outer face of the branches, and extend below the forks for about one-third of the entire length of the style (fig. 19-20). The papillæ occupy the entire inner face of the branches. Brush hairs (fig. 21) are longer than in *Cnicus* and are acuminate.

CICHORIACEÆ (Plate CXX, fig. 22-23).

In this tribe only one genus was examined, viz :

Taraxacum (Fig. 22-23).

T. officinale, Weber. Branches of the style are moderately long and terete. Brush hairs cover the entire outer face, and edges and tip of the inner face of the branches. They extend below the fork for about the length of the branches, and cover the style completely. The style is slightly enlarged below the fork. The papillæ occupy the entire inner face not covered with brush hairs (fig. 23).

CONCLUSION.

From these observations I would say in conclusion that, while there is not enough uniformity in the characters of the style, within the various tribes, to absolutely separate the different tribes in all cases, yet in most cases there is uniformity enough to aid greatly in classification. As has been pointed out by Bentham and Gray, it is impossible to rely upon a single absolute character for the whole order.

In some of the tribes the characters are more constant and uniform than in others. In the tribes Vernoniaceæ, Eupatoriaceæ and Asteroideæ, the characters of the style are very uniform and constant for each tribe, and therefore can be used with great advantage. In the tribe Asteroideæ, sufficient structural differences occur in the genera studied to make two divisions.

In the tribes Helianthoideæ and Cynaroideæ, the characters are sufficiently uniform and constant to be of great aid, though not as much as in Vernoniaceæ, Eupatoriaceæ and Asteroideæ.

In the Helenioideæ, Anthemideæ and Senecionideæ, there is less uniformity and constancy. The style structure is similar in all three tribes, and is of two general kinds. One is constant and distinct for the three tribes, but the other is not sufficiently distinct to prevent its being confused with Helianthoideæ, but it would hardly be mistaken for Vernoniaceæ, Asteroideæ, or Eupatoriaceæ. In these tribes, therefore, the style characters cannot be used as distinctive marks for each tribe, but for the three tribes considered collectively.

Another difficulty met with is in dioecious flowers of Inuloideæ and Helianthoideæ. In these tribes the characteristic arrangement of the brush hairs and stigmatic papillæ cannot be used as characters, since the flowers are either sterile or fertile and pistillate, and so do not possess both brush hairs and stigmatic papillæ. In the tribe Cichoriaceæ only one genus was studied, and so no conclusions can be drawn as to the constancy of the style characters.

So we find, that while the style characters like other characters are of great value in some cases, in others they fail, and must be used in connection with some other characters in order to establish tribes.

Finally, I desire to express my thanks to Prof. L. H. Pammel, for his supervision and direction of my work, and to Mr. W. Zmunt, for carefully retracing my drawings.

EXPLANATION OF PLATES.

Plate CXVII.

Figs. 1-5.—*Vernonia Arkansana*, DC. 1-3 style $\times 30$; 4, portion of fig. 1 enlarged $\times 60$; 5, brush hairs $\times 500$.

Fig. 6.—Brush hairs of *Elephantophus Carolinianus*, Willd. $\times 500$.

Figs. 7-11.—*Kuhnia eupatorioides*, L. 7-8, style $\times 30$; 9, portion of fig. 7 enlarged $\times 60$; 10, brush hairs $\times 500$; 11, stigmatic papillæ $\times 500$.

Figs. 12-14a.—*Mikania scandens*, (L.) Willd. 12, style $\times 30$; 13, portion of style $\times 150$; 14, brush hairs $\times 500$; 14a, stigmatic papillæ $\times 500$.

Figs. 15, 16.—*Eupatorium altissimum*, L. 15, brush hairs $\times 500$; 16, stigmatic papillæ $\times 500$.

Figs. 17, 18.—*Brickellia Wrightii*, Gray. 17, brush hairs $\times 500$; 18, stigmatic papillæ $\times 500$.

Figs. 19, 20.—*Liatris squarrosa*, (L.) Willd. 19, brush hairs $\times 500$; 20, stigmatic papillæ $\times 500$.

Figs. 21-23.—*Trilisia paniculata*, Cass. 21, 22, brush hairs $\times 500$; 23, stigmatic papillæ $\times 500$.

Plate CXVIII.

Figs. 1-3.—*Solidago Canadensis*, L. 1, style $\times 30$; 2, portion of style $\times 60$; 3, brush hairs and stigmatic papillæ $\times 500$.

Figs. 4, 5.—*Grindelia squarrosa*, Dunal. 4, brush hairs $\times 500$; 5, stigmatic papillæ $\times 500$.

Figs. 6, 7.—*Heterotheca*. 6, brush hairs $\times 500$; 7, stigmatic papillæ $\times 500$.

Figs. 8, 9.—*Chrysopsis villosa*, Nutt. 8, brush hairs $\times 500$; 9, stigmatic papillæ $\times 500$.

Figs. 10, 11.—*Aplopappus racemosus*, Torr. 10, brush hairs $\times 500$; 11, stigmatic papillæ $\times 500$.

Figs. 12, 13.—*Bigelovia nudata*, (Michx.) DC. 12, brush hairs $\times 500$; 13, stigmatic papillæ $\times 500$.

Figs. 14, 15.—*Brachyachaeta cordata*, Torr. & Gray. 14, brush hairs $\times 500$; 15, stigmatic papillæ $\times 500$.

Figs. 16, 17.—*Bellis integrifolia*, Michx. 16, brush hairs $\times 500$; 17, stigmatic papillæ $\times 500$.

Figs. 18, 19.—*Townsendia eximia*, Gray. 18, brush hairs $\times 500$; 19, stigmatic papillæ $\times 500$.

Fig. 20.—Brush hairs, staminate flower of *Baccharis halimifolia*, L. $\times 500$.

Figs. 21, 21a.—*Seriocarpus asteroides* (L.) B.S.P. 21, stigmatic papillæ $\times 500$; 21a, brush hairs $\times 500$.

Figs. 22-28.—*Aster-Novæ Angliæ*, L. 22, style of hermaphrodite $\times 30$; 23, portion of style $\times 60$; 24, style of pistillate flower $\times 30$; 25 portion of fig. 24 enlarged $\times 60$; 26, stigmatic papillæ of pistillate flower $\times 500$; 27, brush hairs of hermaphrodite flower $\times 500$; 28, stigmatic papillæ $\times 500$.

Figs. 29-33.—*Erigeron Philadelphicus*, L. 29, 30, style $\times 30$; 31, portion of style $\times 60$; 32, brush hairs $\times 500$; 33, stigmatic papillæ $\times 500$.

Figs. 34, 35.—*Aphanostephus ramosissimus*, DC. 34, brush hairs $\times 500$; 35, stigmatic papillæ $\times 500$.

Figs. 36, 37.—*Boltonia asteroides*, L'Her. 36, brush hairs $\times 500$; 37, stigmatic papillæ $\times 500$.

Fig. 38.—Style of staminate flower of *Baccharis halimifolia*, L. $\times 50$.

Figs. 39, 40.—*Pluchea camphorata*, (L.) DC. 39, style $\times 30$; 40, brush hairs $\times 500$.

Figs. 41-44.—*Antennaria plantaginifolia*, (L.) Hook. 41, style of staminate flower $\times 50$; 42, brush hairs of same $\times 500$; 43, style of pistillate flower $\times 60$; 44, stigmatic papillæ of same $\times 500$.

Plate CXIX.

Figs. 1-5.—*Silphium perfoliatum*, L. 1, style of pistillate flower $\times 30$; 2, portion of style $\times 60$; 3, stigmatic papillæ $\times 500$; 4, portion of style of hermaphrodite flower $\times 30$; 5, brush hairs $\times 500$.

Fig. 6.—Brush hairs of sterile flower of *Polymnia Canadensis*, L.

Fig. 7.—Stigmatic papillæ of pistillate flower of *Berlandiera subcaulis*.

Figs. 8-10.—*Iva xanthifolia*, Nutt. 8, stigmatic papillæ of pistillate flower $\times 500$; 9, style of sterile hermaphrodite flower $\times 50$; 10, brush hairs $\times 500$.

Figs. 11-13.—*Xanthium echinatum*, L. 11, Stigmatic papillæ of pistillate flower $\times 500$; 12, style of sterile flowers $\times 50$; 13, brush hairs $\times 500$.

Figs. 14, 15 —*Heliopsis helianthoides*, (L.) B. S. P. 14, brush hairs $\times 500$; 15, stigmatic papillæ $\times 500$.

Figs. 16, 17.—*Tetragonotheca Ludoviciana*, (T. & G.) Gray. 16, brush hairs $\times 600$; 17, Stigmatic papillæ $\times 500$.

Fig. 18.—Stigmatic papillæ of *Eclipta alba*, (L.) Hassk. $\times 500$.

Figs. 19, 20.—*Echinacea angustifolia*, DC. 19, brush hairs $\times 500$; 20, stigmatic papillæ $\times 500$.

Figs. 21, 22 —*Rudbeckia subtomentosa*, Pursh. 21, brush hairs $\times 500$; 22, stigmatic papillæ $\times 500$.

Figs. 23, 24 —*Lepachys pinnata*, (Vent.) Torr. & Gray. 23, brush hairs $\times 500$. 24, stigmatic papillæ $\times 500$.

Figs. 25, 26 —*Borrichia arborescens*, (L.) DC. 25, brush hairs $\times 500$; 26, stigmatic papillæ $\times 500$.

Figs. 27, 28 —*Helianthus rigidus*, Desf. 27, style of *Helianthus rigidus* $\times 30$; 28, portion of style $\times 60$.

Figs. 29, 30.—*Actinomeris alternifolius*, (L.) D.C. 29, brush hairs $\times 500$; 30, stigmatic papillæ $\times 500$.

Figs. 31-35.—*Coreopsis palmata*, Nutt. 31, 32, style $\times 30$; 33, portion of style $\times 60$; 34, brush hairs $\times 500$; 35, stigmatic papillæ $\times 500$.

Fig. 36.—Brush hairs of *Galinsoega parviflora*, Cav. $\times 500$.

Figs. 37-40.—*Helenium autumnale*, L. 37, style $\times 30$; 38, portion of style $\times 60$; 39, brush hairs $\times 500$; 40, stigmatic papillæ $\times 500$.

Figs. 41, 42.—*Actinella linearifolia* (Hook), Torr. & Gray. 41, brush hairs $\times 500$; 42, stigmatic papillæ $\times 500$.

Fig. 43.—Brush hairs of *Dysodia chrysanthemoides*, Lag. $\times 500$.

Plate CXX.

Figs. 1-4 —*Achillea Millefolium*, L. 1, style $\times 30$; 2, style $\times 50$; 3, stigmatic papillæ $\times 500$; 4, brush hairs $\times 500$.

Fig. 5.—Brush hairs of *Matricaria inodora*, L. $\times 500$.

Figs. 6-10.—*Artemisia Ludoviciana*, Nutt. 6, style of pistillate flower $\times 30$; 7, stigmatic papillæ of same $\times 500$; 8, brush hairs of perfect flower $\times 500$; 9, 10, stigmatic papillæ of same $\times 500$.

Figs. 11, 12.—*Senecio aureus*, L. 11, brush hairs $\times 500$; 12, stigmatic papillæ $\times 500$.

Figs. 13, 14 —*Petasites palmata*, (Ait) Gray. 13, stigmatic papillæ $\times 500$; 14, brush hairs $\times 500$.

Figs. 15, 16. —*Arnica Chamissonis*, Less. 15, style $\times 30$; 16, brush hairs $\times 500$.

Figs. 17, 18.—*Cnicus altissimus*, var. *discolor*, (Muhl.) Gray; 17, style $\times 30$; 18, brush hairs $\times 500$.

Figs. 19–21.—*Centaurea Americana*, Nutt. 19, 20, style $\times 30$; 21, brush hairs $\times 500$.

Figs. 22, 23.—*Taraxacum officinale*, Weber. 22, style $\times 30$; 23, brush hairs $\times 500$.

On the Evolution of Parasitic Plants.

When we observe the complete parasitism of *Phoradendron*, *Arceuthobium* and *Conopholis*, it is difficult to conceive that time was when they grew wholly in the ground. It is not necessary to use the expression, now common, that their ancestors were terrestrial. There seems no reason why these plants, as now existing, may not in the past have grown wholly in the ground.

When we consider the immense number of parasitic Loranths, and the close relation of that order to Santalaceous plants, we might assume some considerable evolution in order to bring the former to the parasitic condition, but for the fact that we find members of the latter family partially parasitic. In 1853 Mr. Jacob Stauffer of Lancaster, Pa., published a paper with drawings of a parasitic *Comandra umbellata*. Carefully washing out roots I could find no such attachment, but have since been rewarded by a beautiful case. The *Comandra* was obtaining most of its support from an attachment to a large root of *Vaccinium stamineum*. A case with an English ally of *Comandra*, *Thesium linifolium*, is noted in Bromfield's *Flora Vectensis*, and approvingly referred to in the third edition of Gray's Text Book. What is there to prevent that which is occasional from becoming habitual and permanent?

Partial parasitism is observed in many families. Mr. Stauffer, in the paper cited, illustrates *Gerardia quercifolia* and *Gerardia flava* in a similar condition, but I have never been able to find a case. This has also been reported of *Castilleja*. I exhibited at the Boston meeting of the American Association for the Advancement of Science carefully prepared colored drawings by Lunzer of *C. coccinea* showing its partial parasitism on the roots of grasses. So far as these instances are concerned it is clear that a plant may easily assume the habit of attachment without any serious modification of structure. We want only some illustrations of



